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Effect of Foliar Spraying by Some Natural Extracts for Improving Snap Bean Production

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TWO FIELD experiments were carried out during two summer season of 2012 and 2013 at the experimental farm of Kaha Station, Qalubia Governorate, to study the influence of foliar nutrition with some natural stimulants on snap bean plants c.v Poulista using ratios of compost tea 1:10, 1:20 and 1:30 (compost: water), licorice extract, yeast extract stimufol compound as well as hammer compound (seaweed extract) and water as a control. The results indicated that spraying with licorice extract had the highest values on number of leaves/ plant, leaf area, fresh and dry/ plant weight and total pods yield, followed by spraying with compost tea at the ratio of (1:30) and yeast extract, respectively, while the treatment of spraying with water gave the lowest values. The best treatments concerning the fresh and dry pod weight were licorice extract and compost tea (1:20). There was no significant effect of all treatments on plant length, pod length or pod diameter, total leaf chlorophyll, N %, K % and protein % on pods during the two growing seasons. Concerning P % in pods its found that using compost tea (1:20) followed by licorice extract were the best treatments .While, licorice and yeast extracts resulted in the highest values of total sugars in both growing seasons, respectively. Generally, spraying bean plants with any of the experiment treatments, especially licorice extract, compost tea (1:30), yeast and compost tea (1:20), respectively encourage green pod yield with best quality.

Snap bean (*Phaseolus vulgaris*, L.) is one of the most important members of leguminous crops in Egypt grown for either local consumption or exportation. Green bean or snap bean is known as an important source for protein and energy in many developing countries. It's rich in dietary fibers, minerals (Ca, P, Fe, K, and Mg & Mn) and vitamins (A, B1, B2 & C) with high percentage of amino acids (Şehirali, 1988).

Nowadays, a great attention is focused on the possibility of using natural and safe agents for promoting growth and yield of vegetable crops specially snap bean. Compost tea is a highly concentrated microorganism's solution produced by extracting beneficial microbes from compost. It can be used as foliar and soil organic nutrients as it contains chelated micronutrients and nutrients in a biologically available form for easy plant absorption. Compost tea is gaining importance as an alternative to chemical fertilizers and pesticides. The microbial population in the compost tea contributes toward its beneficial effectiveness. It has beneficial effects on plant growth and considered as a valuable soil amendment

(Gharib *et al.,* 2008). Compost tea also produce plant hormones; mineralize plant available nutrients; fix nitrogen and providing useful microorganisms that colonize leaf surfaces. Compost quality is the most important factor affecting tea quality and plant growth promotion Edris *et al*. (2003). Moreover, application of compost tea to the root zone can increase root growth and plant yield specially when using extraction ratios of 10:1 - 100:1 (water: compost) by volume, and the response to extraction ratio is generally linear (Radovich *et al*., 2011). Compost tea treatments, to strawberry plants, provided similar amounts of most macro- and micronutrients compared to compost and fertilizer treatments Jennifer *et al.* (2009).

Glycyrrhizia glabra L., family Fabaceae, known as licorice, is a plant grown in Egypt and other countries of the world. Licorice root extract from the licorice plants contain many chemical compounds without side effects on human and the environment, especially; those were used with medicinal and aromatic plants. In this regard, spraying the onion plants or soaking seeds with licorice extract gave the highest leaf area, total chlorophyll and yield (Al-Marsumy & Al-Sahaaf, 2001, Hamood 2010 and Faraj *et al*. 2012). Furthermore, spraying cucumber plant with the same extract increased the leaf area, number of branches and the total content of chlorophyll pigment in the leaves (Hussein, 2002 and Al-Jebouri *et.al* 2010). Licorice extract had significant effect in increased the marketable fruits (Al-Sahaaf *et al.,* 2002). Moreover, licorice root extract increase significantly plant length, leaf area, percentage of chlorophyll, dry weight of plant and also some yield characters as pod weight and length, plant yield and total yield of kidney bean (Abdel- Moniam *et al*., 2011) and (Zuhair *et al*., 2011) on strawberry.

Many studies indicated that yeast is a natural source of cytokinins and has stimulatory effects on bean plants (Amer, 2004). Moreover, yeast extract was suggested to participate in a beneficial role during vegetative and reproductive growth stages through improving flower formation and their set in some plants and that were due to its high auxin and cytokinins content enhancing carbohydrate accumulation (Barnett *et al.,* 1990). Also, the stimulatory effects of yeast on cell division and enlargement, protein synthesis, and chlorophyll formation were reported (Wanas, 2002 & 2006), in addition to its content from sugars, protein, amino acids and also several vitamins. Moreover, the improving of growth, flowering and fruit set of some plants by using foliar application with yeast extract were reported by Fathy *et al.* (2000), Abou-Aly (2005) and Wanas (2006). Many investigations cleared out that, application of dry yeast as a foliar spray was found to increase growth, yield and quality of some vegetable crops Fawzy *et al*. (2010) on snap bean .

Concerning to stimufol compound, it is a commercial product containing macro and micro nutrients, using macro and micro nutrients through foliar fertilization is preferable to avoid not only nutrients obsession in the soil, but also leaching during irrigation. Improving the micronutrient status of plants would increase yield and increase micronutrient content in seeds, leading to

better nutrition of the crop and to improved human nutrition (Johnson *et al.*, 2005). Many workers reported that, spraying plants with foliar fertilizers significantly improved growth, yield and pods quality of legumes crops (El Fouly *et al*., 2010 and El-Habbasha *et al*., 2012).

Regarding to hummer compound which contain 18% seaweed extract, several investigators showed that the great importance of this compounds due to its containts of high levels of organic matter, micro elements (Fe, Cu, Zn, Co, Mo, Mn, and Ni), vitamins and amino acids and also, rich in growth regulators such as auxins, cytokine and gibberellins (Khan *et al.*, 2009). In this respect, all the crude extracts of seaweed increase protein content in shoot systems, total soluble sugars and chlorophyll content in faba bean leaves. (El-Sheekh and Saied, 1999). Exogenous application of seaweed extract has already been shown to enhance plant growth, yield and its quality as reported by Sivasankari *et al*. (2006) on vigna sinensis.

Thus, this study aimed to investigate the effect of some safety compounds, *i.e.* compost tea 1:10, 1:20 and 1:30 (compost: water), licorice extract, yeast extract, stimufol compound as well as hummr compound for improving snap bean growth, pod yield and its quality.

Materials and Methods

The present investigation was carried out during two successive seasons of 2012 and 2013 at the experimental farm, Kaha Station, Qalubia Governorate. Soil was clay in texture with 7.3 pH, 1.23% organic matters, Ec 3.3 m mohs/cm, 112 ppm N, 52 ppm P and 103 ppm K. Seeds of snap bean cv. Poulista were obtained from Horticultural Research Institute, Agriculture Research Center, Egypt and sown on March 8^{th} and 10^{th} in 2012 and 2013, respectively. The seeds of snap bean were sown in hills on one side of ridges at 7 cm spaces. The area of each experimental plot was 2.8 m^2 and consisted of one row (4 m long with 0.70 m width).

The experiment contains eight treatments, i.e. (water as a control, compost tea 1:10, compost tea 1:20, compost tea 1:30, licorice extract, yeast extract, stimufol and hummr) the compounds were used as foliar nutrition. Plants were sprayed three times with aqueous solution of the used materials, the first spray was conducted at the three true leaves stage, whereas the second and third spray were preformed 7 days intervals. All recommended agricultural practices were used.

Preparation of the of Compost tea

Compost tea is prepared by soaking 100 g of plant compost in 1 liter of distilled water for three days and filtered soaked compost (compost tea). Soaked after filtration is used in the preparation of the experimental treatments as ratio, soaked (compost tea): water i.e., 1:10, 1:20 and1:30

Preparation of the licorice extract

Licorice powder root was obtained from the local market. Samples were ground. (5 g) sample were soaked in either 1000 ml water to obtain water extract for 24 hr at room temperature with occasional shaking. Mixture was filtered through cheese cloth followed by filter paper

Preparation of the yeast extract

Baker's yeast (*saccharomyces cerevisiae*) was mixed with sugar at ratio of 1:1 and dissolved in water, then freezing for disruption of yeast cells, (Table 1)

TABLE 1. The treatment materials names, composition and concentration

Compounds name	Composition	Concentration
Control	Distilled water	-
Compost tea 1:10	N (0.1%), P (0.004%), K (1.32 %), Mg (0.011) and Ca (0.008%)	100cm compost tea/ liter water
Compost tea 1:20	N (0.08%), P (0.003%), K (1.35%), Mg (0.010) and Ca (0.007%)	50cm compost tea/ liter water
Compost tea 1:30	N (0.06%), P (0.003%), K (1.36%), Mg (0.010) and Ca (0.007%). Compost tea contents of humic acid 556.5, cytokinins 21.6 ,abscisic acid 41.6(mg/l).	33cm compost tea/ liter water
Licorice extract	N (0.6%), P (0.04%), K (0.3%), Mg (0.17%), micro elements ,pH(5.49),EC(0.7 ds m^{-1}), Antioxidants mg/100g dry weight basis (total phenols 405.02, total flavonoids 114.91, tannins 47.54, saponins 27.99,carotenoids 11.78 and vitamin C 1.20)	5 g/ liter water
Yeast	Baker's yeast contents of protein (5.3%), total carbohydrate (4.7%), N (1.2%), P (0.13%), K (0.3%), Mg(0.013%), Ca (0.02%), Na (0.01%), micro elements	3 g/ liter water
Stimufol	25% N, 16 P, 12%K,0.020% Mg and microelements(Mn,Fe,Mo,Zn,B,Cu	1 g/ liter water
Hummr	9%N,5% P, 6%K,2% S, citric acid 5%, alginic acid 1.4% and sea weed extract 18%	1cm / liter water

Data Recorde

Plant Growth Measurements: A representative sample of 3 plants was taken randomly 55 days after sowing (flowering stage), from each experimental plot for measuring the plant growth characters, as follows:

Plant length (cm), number of leaves, leaf area (cm^2), as well as total fresh weight and dry weight of plant (determined at 65ºC for 72 hours using the standard methods as illustrated by A.O.A.C (1990).

The leaf area was calculated according to the following formula of Wallace and Munger (1965):

Leaf area (cm^2) = Leaves dry weight (gm) x disk area (cm^2)/ Disk dry weight (gm)

Green Pod Yield and its Attributes

A random sample of 10 green pods at the second picking was taken to determine the following data:

Average pod length (cm)- Pod diameter (cm) - Average fresh pod weight (g) - Average dry pod weight (g)- Total pod yield ton/fed (the yield for all pickings)

Chemical properties

Total leaf chlorophyll was measured using Minolta chlorophyll Meter SPAD-501 as SPAD units. Total protein % was determined as nitrogen of pod content and converted to its equivalent protein content by multiplying N content in 6.25 (A.O.A.C., 1990).

Total nitrogen, phosphorus and potassium were determined in dry pod on the basis of dry weight according to the methods described by Bremner & Mulvaney (1982), Olsen & Sommers (1982) and Jackson (1967), respectively.

Total sugars was determined on the basis of pod dry matter, calorimetrically using spectrophotometer with the phenol sulphuric acid method described by Dubois *et al.* (1956)

Statistical Analysis: The experiment was carried out in complete randomized block design with three replicates. All data were subjected to statistical analysis according to the procedures reported by Snedecor and Cochran (1982) using M. stat program and means were compared by L.S.D multiple range tests at the 5 % level of probability in the two seasons of experimentation.

Results and Discussion

Plant Growth Measurements

Results of Table 2 showed some characteristics of vegetative growth i.e. no. of leaves/ plant, plant length, leaf area, fresh and dry plant weight. The data illustrated that, spraying of licorice extract had the highest values of no. of leaves/ plant , leaf area ,fresh and dry plant weight followed by spraying with compost tea (1:30) and yeast extract, respectively. But the treatment of spraying with water gave the lowest values. Regarding to plant length data indicated that

there is no significant effect from using all treatments in both growing seasons. Spraying with licorice extract has led to increase the vegetative growth of kidney bean (Abdel – Moniam *et al.* (2011) and (Zuhair *et al.*, 2011) on strawberry, these attributed of licorice extract was similar to the behavior of GA3 which contained mevalonic acid that improve the vegetative growth as a result of stimulating the enzymes that necessary to convert complex compounds into simple compounds, and exploited in the processing of the energy required for plant growth. The beneficial effect of compost tea may be due to both supply nutrients and microbial functions. It can provide chelated microelements and make them easier for plants to absorb. Moreover, Stimulating vegetative growth by using dry yeast may be due to its influence on the nutritional signal transduction producing growth regulators and suppressing pathogen. It is also a natural source of cytokinins that stimulates cell proliferation and differentiation these results are in harmony with those obtained by (Gharib *et al.*, 2008), Fathy *et al.* (2000), Abou-Aly (2005) and Wanas (2006).

TABLE 2 Effect of foliar spray with some nutritional materials on vegetative growth of snap bean plants during the two seasons of 2012 and 2013.

Treatments	Plant length (cm)		No. of. leaves / plant		Leaf area (cm^2)		Fresh weight/ plant (g)		Dry weight/ plant (g)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Water (control)	38.17	39.33	16.75	17.33	129.31	137.42	54.85	56.80	9.92	12.62
Compost tea: water 1:10	41.17	43.54	19.75	21.83	156.67	160.85	75.81	71.23	12.82	12.18
Compost tea: water 1:20	41.33	42.75	18.25	22.25	204.06	219.98	79.64	80.85	15.05	13.52
Compost tea: water 1:30	41.33	43.50	22.25	24.00	225.56	223.95	82.80	84.65	15.47	13.60
Licorice extract	42.67	45.25	22.50	24.33	245.22	236.08	86.65	93.40	15.50	15.69
Yeast extract	42.00	44.25	21.75	23.00	218.89	227.09	78.18	83.53	13.67	15.42
Stimufol	40.40	40.17	19.00	18.50	201.49	202.22	74.10	74.20	12.23	12.90
Hummr	39.00	41.00	17.25	19.00	198.73	192.49	73.30	71.46	12.45	12.22
L.S.D at 5%	N.S	N.S	2.63	3.38	48.81	53.14	16.55	15.88	2.32	N.S

Green Pod Yield and its Attributes

As shown in Table 3, there were significant differences in the produced total pods yield of snap bean among the different foliar spray treatments. The highest total pods yield was produced by using licorice extract and compost tea (1:30) followed by yeast extract. Concerning the fresh and dry pod weight using licorice extract and compost tea (1:20) were the best treatments. On contrary, the lowest total yield of snap bean was recoded by the control treatment (foliar spray with water). These results were true in the two seasons of the study. The positive effect of applying licorice extract and compost tea (1:30) could be expected because its have favorable conditions for increasing snap bean vegetative growth as shown in Table 2. These results agreements with those obtained by (Al-Marsumy and Al-Sahaaf, 2001, Hamood 2010 and Faraj *et al.*, 2012) on onion and on kidney bean (Abdel – Moniam *et al.*, 2011) and (Zuhair *et al.*, 2011) on

strawberry. Data in Table 3 show that, there is no significant effect from using all treatments on pod length or pod diameter in both growing seasons.

TABLE 3. Effect of foliar spray with some nutrition materials on green pod yield and its attributes of snap bean plants during the two seasons of 2012 and 2013.

Treatments	Pod length (cm)		Pod diameter (cm)		Fresh pod weight (g)		Dry pod weight (g)		Pod yield (ton/fed)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Water (control)	11.32	11.45	0.62	0.61	2.65	2.82	0.26	0.21	2.89	2.36
Compost tea: water 1:10	11.71	11.80	0.63	0.62	3.29	3.42	0.26	0.26	3.85	2.37
Compost tea: water 1:20	11.87	12.00	0.61	0.62	3.51	3.44	0.27	0.28	3.82	3.78
Compost tea: water 1:30	11.39	11.85	0.62	0.62	3.49	3.53	0.27	0.26	4.22	4.38
Licorice extracts	11.43	12.45	0.61	0.62	3.81	3.84	0.39	0.31	4.24	4.45
Yeast extracts	11.38	11.62	0.62	0.61	3.40	3.61	0.26	0.27	3.94	3.87
Stimufol	11.50	11.96	0.62	0.62	3.17	3.38	0.29	0.26	3.76	3.30
Hummr	11.12	11.73	0.62	0.60	2.83	3.33	0.24	0.25	3.71	3.22
L.S.D at 5%	N.S	N.S	N.S	N.S	0.66	N.S	0.04	N.S	0.75	1.15

Chemical properties

Data of total chlorophyll, K %, N % and protein % tabulated in Table 4. The results show that there is no significant effect of the compounds used on the characteristics mentioned in Table 4. Concerning P % its clear that using compost tea (1:20) followed by licorice extract were the best treatments. While, licorice and yeast extracts gave the highest values of total sugars, respectively in both growing seasons. These results may due to its content of sugars, protein, amino acids and also several vitamins. Compost tea also produces plant hormones; mineralize plant available nutrients and fixes nitrogen Edris *et al.* (2003).

Conclusion

In the present study, generally it can recommend by spray bean plants with any one of the compounds used in this experiment especially licorice extract, compost tea (1:30), yeast and compost tea (1:20) extract, respectively to obtain favorable green pod yield with best quality.

TABLE 4. Effect of foliar spray with some nutrition materials on pod chemical properties and leaf chlorophyll of snap bean plants during the two seasons of 2012 and 2013

Treatments	Leaf chlorophyll SPAD unit		Total sugars (%)		Protein (%)		N (%)		P (%)		K (%)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Water (control)	40.50	37.07	15.17	16.30	11.87	11.37	1.90	1.82	0.51	0.52	1.98	1.90
Compost tea: water 1:10	41.50	41.85	15.97	17.24	14.87	15.31	2.38	2.45	0.52	0.51	2.14	2.36
Compost tea: water 1:20	41.50	42.05	16.61	19.72	14.00	14.00	2.24	2.24	0.58	0.57	2.04	2.04
Compost tea: water 1:30	44.30	43.47	16.57	19.34	13.12	14.00	2.10	2.24	0.53	0.53	2.10	2.39
Licorice extracts	43.38	42.95	17.74	20.89	13.12	13.56	2.10	2.17	0.57	0.54	2.11	2.21
Yeast extracts	43.55	43.00	16.64	19.75	13.12	13.56	2.10	2.17	0.53	0.52	2.25	2.41
Stimufol	41.95	42.70	16.12	17.41	12.25	11.81	1.96	1.89	0.52	0.52	2.19	2.21
Hummr	41.90	41.73	16.59	19.46	13.12	14.00	2.10	2.24	0.53	0.53	2.21	2.27
L.S.D at 5%	N.S	N.S	N.S	1.22	N.S	N.S	N.S	N.S	0.02	0.03	N.S	N.S

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تاثير الرش الورقى ببعض المستخلصات الطبيعية لتحسين انتاجية الفاصوليا

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اجريت تجربتين خلال الموسم الصيفى لعامى ٢٠١٢و٢٠١٣ فى محطة التجارب بقها محافظة القليوبية. لدراسة تاثير الرش الورقى ببعض المنشطات الطبيعية على نباتات الفاصوليا صنف بوليستا وذلك باستخدام مستخلص الكمبوست (١:١٠) و(١:٢٠) و(١:٣٠) كمبوست: ماء ،مستخلص العرقسوس و مستخلص الخميرة ، مركب ستيموفول، مركب همروالماء (كنترول). أوضحت النتائج أن الرش بمستخلص العرقسوس أعطى أعلى القيم من عدد الأوراق،مساحة الورقة ، الوزن الطازج والجاف للنبات والمحصول الكلى للقرون يليه الرش بمستخلص الكمبوست (١:٣٠) ومستخلص الخميرةعلى التوالى مقارنة بمعاملة الكنترول أما بالنسبة للوزن الطازج والجاف للقرن فان استخدام مستخلص العرقسوس والكمبوست (١:٢٠) كانت افضل المعاملات ولم يكن هناك تأثير معنوى باستخدام كل المعاملات على طول النبات، طول القرن وقطر القرن والكلوروفيل بالورقة ،ونسبة النيتروجين والبوتاسيوم والبروتين بالقرن فى كلا الموسمين.أما بالنسبة للفوسفور كان استخدام كمبوست (١:٢٠) يتبعه مستخلص العرقسوس أفضل المعاملات بينما كان مستخلص العرقسوس ومستخلص الخميرة على التوالى افضل بالنسبة للسكريات الكلية.بوجه عام يمكن التوصية برش نباتات الفاصوليا بأى من المركبات المستخدمة بالدراسة خاصة مستخلص العرقسوس ومستخلص الكمبوست (١:٣٠) ومستخلص الخميرة ومستخلص الكمبوست (١:٢٠) للحصول على أفضل محصول من قرون الفاصوليا الخضراء وبجودة عالية .